Patent Application

Title Of The Invention

GAS-OPERATED GUNS WITH DEMOUNTABLE AND INTERCHANGEABLE BARREL SECTIONS AND IMPROVED ACTUATION CYLINDER CONSTRUCTION

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BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates broadly to gas-operated automatic and semi-automatic guns, especially rifles. More particularly, it concerns such guns that comprise (a) a bisectional barrel with demountable and interchangeable muzzle sections and (b) an actuation cylinder mounted to the receiver instead of the barrel.

2. Description of the Prior Art

There is a recognized need for guns that can easily change barrel length and that can facilitate the use of non-standard ammunitions in battle conditions. This invention provides improvements in gun construction that supply these needs with greater weapon reliability and adaptability than has been attainable with prior known guns.

It is known to construct guns with bisectional barrels in which the breech section bore is smooth and the muzzle section bore is rifled. Thus, U.S. Patents 4,546,564 and 4,660,312 disclose such bisectional barrels in which the rear end of the muzzle section threads into the front end of the breech section while USS Reg. No. H1365 discloses bisectional gun barrels in which a rifled bore muzzle section is fixed at its rear end to the front end of the breech section by a collar.

Rifles with barrels having a rifled bore breech section and a smooth bore muzzle section have also been previously disclosed in U.S. 4,527,348.

Gas operated guns capable of firing several different cartridges and that permit a user to adjust the gas systems to change the amount of gas used to cycle the gun's operating system to compensate for differences in cartridges have been disclosed in U.S. 5,900,577.

There is also a recognized need for gas-operated guns that can provide a consistently low dispersion of fired shots without being detrimental to reliable functioning of the gun. This invention provides improvements in gun construction that meet this need.

There are a large number of weapons that have been developed and sold having a gas cylinder that is mounted directly to the barrel. Notable examples are the Soviet AK family, FN FAL, and the US Ml, M14, Ml Carbine and M60 Machine Gun. In these weapons the propellant gas is ported from the barrel into the gas system which then creates a rearward force that pushes the operating mechanism of the weapon to the rear

to perform the functions of unlocking, extraction, ejection, feeding and relocking the bolt, e.g., see U.S. 4,475,438 and 5,246,758.

With all of these systems the barrel becomes the structural member that directly resists the energy supplied to create the rearward travel of the operating mechanism components. This load on the barrel results in unwanted barrel movement at the time the projectile leaves the muzzle causing serious dispersion of the resulting shots. The M16 Rifle made a notable change from this historical pattern in that it transmitted the gas to a gas cylinder within the receiver via a gas tube, e.g., see U.S. 4,765,224; 5,351,598 and 5,726,377. The AR10/AR15 family of weapons thus enjoyed a substantially better accuracy than all of its predecessors.

The gas tube transports the propellant gas from the barrel to the bolt carrier where that pressure is subjected to the rear of the bolt and the bolt carrier. When the pressure is applied, the bolt cannot move forward because it is pushing against the cartridge case and the rear of the barrel. The loads applied to the barrel at that location are offset by the loads applied by the same chamber pressure pushing back against the bolt. Even though there are big loads involved at the bolt to barrel junction, those loads are all in-line with the axis of the barrel and cause no barrel deflection. What can move is the bolt carrier, which, as a result of the pressure, starts to move to the rear. When the bolt carrier has moved approximately 0.30 inches, ports open and exhaust the gas pressure to atmosphere. The load that is transmitted to the barrel is the product of the instantaneous pressure inside the gas tube and the cross-sectional area of the gas tube. Similarly, the load applied between the bolt and the bolt carrier is the product of the piston area times the same instantaneous pressure. In the case of the M16 family of rifles the cross-sectional area of the bolt piston is 0.138 square-inches vs. the 0.025 square-inches of the gas tube. Thus the M16 applies only 18% of the load required to operate the gun to the barrel instead of the 100% that most guns apply. Hence it is easy to see that the deflection of the barrel is far less when a gas tube is used. The AR10/AR15 family of weapons thus enjoyed a substantially better accuracy than all of its predecessors.

The drawback to the M16 design is that it dumps that gas directly into the working mechanism that has historically been a detriment to reliable functioning. The present invention provides new gun constructions that eliminate such detriment.

OBJECTS

A principal object of the invention is the provision of improvements in construction of gas-operated automatic and semi-automatic guns, especially rifles, by the provision of new types of guns that comprise bisectional barrels with demountable and interchangeable muzzle sections.

Another object is the provision of gas-operated automatic and semi-automatic guns comprising actuation cylinders mounted to the receiver instead of the barrel.

Further objects include:

1. The provision of gas-operated automatic and semi-automatic guns with bisectional barrels capable of automatically altering firing parameters with changes in muzzle barrels to accommodate for multiple versions of non-standard ammunitions.

2. The provision of gas-operated guns that can provide a consistently low dispersion of fired shots without being detrimental to reliable functioning of the gun.

3. The provision of gas-operated guns that do not dump operation gas directly into the breech working mechanism.

4. The provision of improvements in guns that have particular application to the M16/M4 series of rifles.

Other objects and further scope of applicability of the present invention will become apparent from the detailed descriptions given herein. It should be understood, however, that the detailed descriptions, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent from such descriptions.

SUMMARY OF THE INVENTION

The objects are accomplished in part by the invention via provision of improved guns that comprise a bisectional barrel configured with a breech section and a muzzle section, selected from a plurality of muzzle sections, operatively joined by a unique socket type connection. In preferred embodiments, the bore of the breech barrel section is rifled and the bore of the muzzle section is either smooth (without any rifling) or is rifled as suits the specific application. Further, the rear of the breech section is fitted to a chamber that operatively connects the breech section to the gun's receiver. The length of the breech section remains constant while the total length of the gun varies with the length of the muzzle section selected from time to time by the user.

In preferred embodiments, the front end of the constant length breech section is approximately eight inches forward of the back of the chamber. There is approximately six inches of conventionally rifled bore. This breech section length is long enough to cause projectiles shot from the gun to spin at a rotational velocity that is sufficient to stabilize the flight of the projectile.

The forward end of the breech section terminates with a tapered socket that mates with a tapered plug at the rear end of a muzzle section to form the full bisectional barrel.

An alignment pin extends rearwardly from the tapered plug to operatively align the muzzle section with the beech section.

The front end of the breech section has external threads that mate with threads of a collar nut captive on the rear end of the muzzle section to operatively connect the muzzle section to the breech section to provide a continuous bore from the rear end of the breech section to the front end of the muzzle section.

The front end of the muzzle section is externally threaded to attach various auxiliary devices, e.g., silencers and multifunctional muzzle attachments as disclosed in U.S. 6,595,099, the contents of which are incorporated herein by reference.

The rear face of the tapered plug of the muzzle section has a first radial port that joins with a second radial port in the base of the tapered socket of the breech section. The combination of the first and second radial ports provides a passage for propellant gas to flow from the bore of the gun barrel to the outlet end of the second radial port to provide the gas pressure for the operation of the gun.

The size of the first radial port controls the volume of gas that is released to the gas system of the gun. Hence, each muzzle barrel portion can be selectively tuned by sizing its first radial port to provide the proper amount of gas to automatically cause the weapon to function at its desired cyclic rate based on the ammunition, silencer and length of the muzzle section selected by the user.

As a further improvement of the invention, there can be provided a silencer that interfaces directly with the breech section of the barrel with the same attachment mechanism that has the proper gas port size for use with that silencer-ammunition combination.

A further improvement in gun construction provided by the invention is to mount the actuation cylinder directly to the receiver. A mechanical system operated by the actuation cylinder performs the gun functions of unlocking, extraction, ejection, feeding and relocking,

The operation gas is transmitted from the barrel to the actuation cylinder thru a flexible tube that effectively isolates the barrel from the mechanical system. In this way the invention provides a system that keeps the propellant gas out of the other working portions of the gun. The invention achieves this by attaching the barrel to the receiver in an un-conventional manner so the invention provides a gun that has the reliability and cleanliness of a gas piston forward of the bolt and bolt carrier with the accuracy associated with a free-floating barrel.

The actuation cylinder housing is mounted to the upper receiver with threaded fasteners (flat head machine screws) and with two dowel pins. The actuation cylinder housing fits into a longitudinal slot in the upper receiver that supports the sides of the actuation cylinder housing. Axial loads (along the axis of the barrel) are taken by the dowel pins. The actuation cylinder has appendages protruding from its top surface that act as the anchor points to the upper receiver.

The gas tube transports the propellant gas from the barrel to the actuation cylinder. The gas pressure acts via the actuation cylinder upon the mechanical system to perform the gun functions of unlocking, extraction, ejection, feeding and relocking, by the force of the applied gas to the actuation cylinder. The reaction forces from all of this motion are transferred directly to the receiver via the anchor points on the actuation cylinder. In this way the barrel sees only what strain can be applied to it by the pressure buildup in the gas tube. In this case the effective load applied to the barrel is even less than the 18% that the M16/M4 sees because the gas tube is rigidly attached at each end preventing it from acting as a piston.

The barrel is mounted to the upper receiver with a combination of a bonded joint, four bolts and additionally supported by the guide rails for the bolt. In preferred embodiments, the barrel is bonded to the carbon-fiber upper receiver with an epoxy-based compound. When the bond joint is laid in, four machine screws pull the barrel into contact with the upper receiver keeping the bond joint as thin as possible. After the barrel joint has cured, the guide rails for the bolt and bolt carrier are bonded and riveted

in place behind the barrel. The barrel mounting thus described provides a method of achieving a full floating barrel where foreword, beyond the chamber, the barrel does not contact the handguard or the gas system except with the gas tube. Accordingly, guns made in accordance with the invention have greater accuracy than guns whose gas system mounts to the barrel and the reaction forces from that interaction are mechanically taken by the barrel.

In accordance with a preferred embodiment of the invention, the gas is transmitted from the gun barrel to the actuation cylinder thru a "U" shaped tube that effectively isolates the barrel from the actuation cylinder. In this way, the invention provides a new system that keeps the propellant gas out of the other working portions of the weapon. This is attained in accordance with the invention with threaded fasteners and the guide rails for the mechanical system that is fastened to the receiver as well. The result is a weapon that has the reliability and cleanliness of a gas piston forward of the bolt and bolt carrier with the accuracy associated with a free-floating barrel.

Construction of guns in accordance with the invention will prove to be beneficial to gun users who want the ability to change the length of the barrel as well as those who want to tune the gun to work optimally with a particular round of ammunition or silencer. In the past what was required was having a dedicated upper receiver assembly for each of these instances. The volume required to store these front barrel extensions is dramatically less that than required for the storage of the complete upper receiver assembly. The front barrel extensions are also much less expensive than an entire new upper receiver assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the invention can be obtained by reference to the accompanying drawings in which:

FIG. 1 is an elevational side view of the forward part of one preferred embodiment of a rifle constructed in accordance with the invention equipped with the medium length version of the barrel muzzle section, selected from the gun's plurality of muzzle sections.

FIG. 2 is a longitudinal sectional side view corresponding to FIG. 1.

FIG. 3 is an enlarged isometric rear view of the long version of a muzzle section of the gun shown in FIG. 1.

FIG. 4 is an enlarged isometric rear view of the medium length version of a muzzle section of the gun shown in FIG. 1.

FIG. 5 is an enlarged isometric rear view of the short version of a muzzle section of the gun shown in FIG. 1.

FIG. 6 is an enlarged sectional view of a central portion of the rifle as shown in FIG. 1.

FIG. 7 is a right side view of the forward end of the rifle of FIG. 1 with the receiver removed.

FIG. 8 is an isometric front-end view of the breech muzzle section of the rifle of FIG. 1.

FIG. 9 is a left side view of the rifle similar to the right side view of FIG. 7.

FIG. 10 is an enlarged oblique view of the middle portion of the left side of the rifle of FIG. 1 with the receiver in place.

FIG. 11 is an enlarged oblique view of the middle portion of the right side of the rifle similar to FIG. 10, but more clearly showing that the actuation cylinder does not touch the barrel of the rifle.

FIG. 12 is a sectional view taken along line 12-12 of FIG. 10.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring in detail to the drawings beginning with FIGs. 1 & 2, the improved gun 2 of the invention comprises a bisectional barrel 4 having a breech section 6 defined by a breech front portion 8 and a breech rear portion 10 plus a demountable and interchangeable muzzle section 12 defined by a muzzle front portion 14 and a muzzle rear portion 16.

The gun 2 includes chamber 18 that is defined by a rear end 20 and front end 22. Chamber 18 is operatively connected by its front end 22 to breech rear portion 10.

The receiver 24 constitutes a major component of the gun 2. The rear end 20 of chamber 18 is mounted to receiver 24 to accept ammunition therein in known fashion of operation of M16 rifles. Also, an actuation cylinder 26 is mounted to the receiver 24 in manner explained further below.

Located within the receiver 24 there is a mechanical system 28, operated by the actuation cylinder 26, to perform in known manner the gun functions of unlocking, extraction, ejection, feeding and relocking.

The rear portion 10 of breech section 6 bears external threads 29 to connect the breech section 6 to the front end 22 of chamber 18.

The breech section 6 comprises a rifled bore 30 that extends forward from the front end 22 of the chamber 18 and the muzzle section 12 comprises a smooth bore 32.

Referring to drawings 3-5, in a preferred embodiment of the invention there is a complement of three interchangeable muzzle sections of different length. Thus, long muzzle section 12 is shown in FIG. 3, medium muzzle section 12M is shown in FIG. 4 and the short muzzle section 12S is shown in FIG. 5, enlarged relative to FIGs. 3 & 4 to more clearly show structural details.

Referring now to FIG. 6, the front end 32 of front portion 8 of the breech portion 6 of gun 2 is defined by an tapered socket 34 having a base 36. The rear end 38 of muzzle rear portion 16 is defined by a tapered plug 40 having face 42. The tapered plug 40 is configured to mate with the tapered socket 34 and the bisectional barrel 4 is formed by joining muzzle section 12 to beech section 6 by junction of the tapered plug 40 with the tapered socket 34. To do this, the front end 8 of breech section 6 has external threads 44 that mate with threads 46 of a collar nut 48 captive on the rear end of the muzzle section 12 to operatively connect the muzzle section 12 to provide a continuous bore B from the rear end of said breech section (not shown in FIG. 6) to said front end of muzzle section 12 (not shown in FIG. 6).

Referring to FIGs. 5, 6 & 8, the tapered plug 40 of muzzle section 12S has a first port 50 that joins with a second port 52 in the base of tapered socket 34 of the breech section 6. The combination of first and second ports 50 & 52 provides a passage for propellant gas to flow from the bore B of the gun barrel to said actuation cylinder 26. The first port 50 is sized to control the volume of gas that is passed to actuation cylinder 26 and this sizing feature applies to other muzzle sections, e.g., middle length muzzle section 12M (FIG. 4) and long length muzzle section 12 (FIG. 3).

An alignment pin 53 extends forward from the tapered socket 34 to operatively align the muzzle section 12 with the beech section 6. Tapered plug 40 contains a groove 54 to receive one end of the alignment pin 53 and breech section 6 also contains a groove 54A to receive the other end of alignment pin 53.

The front ends of the muzzle sections 12, 12M & 12S have external threads 55 to attach auxiliary devices A (see FIG. 1).

Referring to FIGs. 6 -11, the actuation cylinder 26 is mounted to the receiver 24 (not shown in FIGs. 7 & 9) that extends over a portion of the actuation cylinder 26 and over most of the breech portion 6 of the barrel 4.

As previously noted, the mechanical system 28 is positioned in the receiver 24 and operated by the piston 59 of the actuation cylinder 26 to perform the gun functions of unlocking, extraction, ejection, feeding and relocking.

A "U" shaped tube 60 connects the bore B of the barrel 4 to the actuation cylinder 26 for passage of propellant gas from the bore B to the actuation cylinder 26 while effectively shielding the barrel 4 from positional movements of the actuation cylinder 26 caused by interaction between the actuation cylinder 26 and the mechanical system 28.

Threaded fasteners 62 help support the actuation cylinder 26 and the mechanical system 28 in the receiver 24 and enable the free floating of the barrel 4. Dowel pins 63 take loads along the axis of the barrel 4.

With reference to FIGs. 6 - 9, a complex collar 64 surrounds the front end 32 of front portion 8 of the breech portion 6 of gun 2. The collar 64 comprises a hood 66 that is positioned over the second port 52 to receive gas from the barrel bore B via the passage formed of first port 50 and second port 52. In turn, the inlet end 68 of U-tube 60 is connected to the hood 66 to conduct the ported gas to the outlet end 70 of U-tube 60 for discharge into the actuation cylinder 26 to reciprocate the piston 59 for operation of the mechanical system 28.

Tests using M16 rifles with bisectional barrels in accordance with the invention have recorded a slight increase in projectile velocity over that of the one-piece barrel of the same length. Also, the tests have revealed improved accuracy and point of impact shift as the barrels are changed.

The taper socket/plug connection of breech barrel section 6 with muzzle barrel section 12 has demonstrated the ability to consistently repeat. It was found that a 16-degree included angle for the sockets 34 and plugs 40 is as small as one should go without having the taper become self-locking. The gap between the rear 42 of the front barrel section 12 and the base 36 of the socket 34 in the breech barrel section 6 is controlled through the use of gauging and grinding the seats and taper portions of the sockets 34 and plugs 40.